

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07530

SINGLE PLY MEMBRANE ROOFING

06/04

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, HANDLING, AND STORAGE
- 1.4 SAMPLES AND TESTING
- 1.5 PROTECTION OF PROPERTY

PART 2 PRODUCTS

- 2.1 ADHESIVES
- 2.2 ASPHALT PRIMER
- 2.3 ASPHALT
- 2.4 BASE SHEET
- 2.5 CANTS
- 2.6 CEMENT
- 2.7 NAILS AND FASTENERS
  - 2.7.1 General
  - 2.7.2 Roofing Nails
  - 2.7.3 Fasteners
  - 2.7.4 Powder-Driven Fasteners
  - 2.7.5 Metal Disks
- 2.8 FINISH COATING
  - 2.8.1 General
  - 2.8.2 Color
- 2.9 FINISHING TAPE
- 2.10 FLASHING MEMBRANES
- 2.11 ROOFING MEMBRANES
- 2.12 SHEATHING PAPER
- 2.13 ROOF WALKWAYS

PART 3 EXECUTION

- 3.1 PREPARATION OF SURFACES
- 3.2 APPLICATION OF ROOFING
- 3.3 ROOFING TYPE
- 3.4 SUBSTRATE
  - 3.4.1 Type A Roofing on Wood
  - 3.4.2 Type A Roofing on Gypsum or Insulating Concrete
  - 3.4.3 Type A Roofing on Concrete

- 3.4.4 Type A Roofing on Insulation or Underlayment
- 3.4.5 Type B Roofing
- 3.5 FASTENING
  - 3.5.1 Type A Roofing Laid Directly on Deck
  - 3.5.2 Type A Roofing Laid on Insulation or Underlayment
  - 3.5.3 Type B Roofing Laid Directly on Deck
  - 3.5.4 Type B Roofing Laid on Insulation or Underlayment
- 3.6 FINISH COATING FOR TYPE B ROOFING
- 3.7 FLASHINGS
  - 3.7.1 General
  - 3.7.2 Base Flashing
  - 3.7.3 Cants
  - 3.7.4 Strip Flashings
  - 3.7.5 Valleys
  - 3.7.6 Valley Application
  - 3.7.7 Walkway Application
  - 3.7.8 Roof Vent Application
- 3.8 FIELD TESTING ROOF CUTOUT SAMPLES
  - 3.8.1 Roof Cutout Samples
  - 3.8.2 Testing Procedures
- 3.9 ACCEPTANCE

-- End of Section Table of Contents --

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SECTION 07530

SINGLE PLY MEMBRANE ROOFING  
06/04

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers elastic roofing sheet-applied for application directly on decks and insulation.

Drawings must include details for all flashing systems, roof drains, roof-edge design vents for roof insulation, and other construction features of the roofing system.

Vapor barriers must be indicated for high-humidity areas and wherever the winter fresh-air make-up is less than 30 cfm per occupant.

On flat roofs without parapet, roof periphery must be provided with a 5-inch 125 millimeter cant and an over-the-apex fascia detail to prevent winddriven roof water from flooding the vulnerable junction of the roofing system and the metal gravel stop.

Where vapor barriers are used, design details must provide for continuous venting of the barrier-insulation-membrane sandwich at the entire periphery and at all curbs.

Metal flashing and pitch pans are specified in Section 07600, "Flashing and Sheetmetal."

Roof insulation is specified in Section 07220, "Roof and Deck Insulation."

Parenthetical material indicates a choice and must be edited as appropriate for the project.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be manually edited except to add new references.

References not used in the text will automatically  
be deleted from this section of the project  
specification.

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The publications listed below form a part of this section to the extent  
referenced:

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2003) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 1084	(1997) Standard Test Method for Viscosity of Adhesives
ASTM D 1148	(1995; R 2001) Standard Test Method for Rubber Deterioration - Heat and Ultraviolet Light Discoloration of Light-Colored Surfaces
ASTM D 1149	(1999) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 146	(1997e1) Standard Test Method for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D 1544	(1998) Standard Test Method for Color of Transparent Liquids (Gardner Color Scale)
ASTM D 2178	(1997a) Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 2240	(2003) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 297	(1993; R 2002e1) Standard Test Method for Rubber Products - Chemical Analysis
ASTM D 312	(2000) Standard Specification for Asphalt Used in Roofing
ASTM D 41	(1994; R 2000e1) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 412	(1998a; R 2002e1) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D 471	(1998e1) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D 517	(1998) Standard Specification for Asphalt Plank
ASTM D 573	(2002) Standard Test Method for Rubber-Deterioration in an Air Oven
ASTM D 624	(2000e1) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 746	(1998e1) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 828	(1997; R 2002) Standard Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation-Apparatus
ASTM E 903	(1996) Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
ASTM E 96	(2000e1) Standard Test Methods for Water Vapor Transmission of Materials

## 1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01330, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

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The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

### SD-02 Shop Drawings

Installation drawings for elastic sheet roofing shall be in accordance with the paragraph entitled, "Application of Roofing," of this section.

### Type B Roofing Membranes

### SD-03 Product Data

Manufacturer's catalog data for the following items shall include roofing felts, primers, bitumens, and surfacing aggregate.

Adhesives  
Asphalt Primer  
Asphalt  
Base Sheet  
Cants  
Cement  
Nails and Fasteners  
Finish Coating  
Finishing Tape  
Flashing Membranes  
Roofing Membranes  
Sheathing Paper  
Roof Walkways

#### SD-04 Samples

Contractor shall submit the following samples in accordance with the paragraph entitled, "Samples and Testing," of this section.

Construction Materials  
Base Sheet  
Roofing Membranes  
Finish Coating

#### SD-06 Test Reports

If approved [by the Contractor], certified copies of test reports for test performed within one year of the date to proceed with construction can be submitted. The test report must be from approved laboratories and on materials representative of those proposed for use.

Adhesives  
Asphalt Primer  
Asphalt  
Base Sheet  
Cants  
Cement  
Nails and Fasteners  
Finishing Tape  
Flashing Membranes  
Roofing Membranes  
Sheathing Paper  
Roof Walkways

#### SD-07 Certificates

Certificates for the following items shall indicate the manufacturer and manufacturer's designation and shall exactly identify each item by the designation that will appear on the packaging for that item.

Felt  
Base Sheet  
Flashing Membranes  
Bitumens  
Mastics  
Insulation  
Adhesives

#### SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for the installation of the following items:

Roofing  
Insulation  
Roofing Membranes  
Flashings

#### SD-11 Closeout Submittals

Warranty

### 1.3 DELIVERY, HANDLING, AND STORAGE

Roofing materials shall be on the project site before work is begun.

Materials shall be delivered to the site in the manufacturer's unbroken, labeled packages. Felt rolls shall be labeled to indicate grade, weight, and type of saturant. Original packaging shall not be disturbed until materials are to be applied. Liquid materials shall be used directly from the fully labeled cans in which they were shipped by the manufacturer. Only approved roofing materials shall be brought to or stored at the site.

Roofing materials shall be stored and protected from contact with soil, rain, or snow. Felt rolls and roll roofing shall be stacked on end and stored in an area maintained at a temperature no lower than 50 degrees F 10 degrees C for at least 24 hours before laying.

Not more than a 1-day's supply of insulation or Felt shall be stored on the roof at any time. This 1-day's supply shall be stacked on pallets and completely covered with plastic sheeting whenever work is interrupted or when there is precipitation of any kind. Plastic sheeting shall be securely fastened to the pallets and be completely weathertight. Materials not so protected during inclement weather shall be permanently removed from the site.

Materials temporarily stored on the roof shall be distributed to stay within the indicated live-load limits of the roof construction, which is [\_\_\_\_\_] pounds per square foot newton per square meter. Ample bases shall be provided under equipment to distribute the weight to conform to these live-load limits. Storage locations shall be approved.

### 1.4 SAMPLES AND TESTING

Samples shall be clearly identified by designated name, batch number, date of manufacture, project contract number, intended use, and quantity involved. Samples shall be tested for conformance to specified requirements. Costs of the first test will be paid by the Government. If the sample fails to meet specification requirements, the material represented by the sample shall be replaced and the cost of retesting will be deducted from the payment due the Contractor at the rate of [\_\_\_\_\_] dollars per sample retested.

Samples include:

Three 1-quart 1 liter samples of each liquid Construction Materials on site.

Upon notification by the Contractor that the material is at the site, three 1-quart 1 liter samples of each liquid material shall be taken by random selection from the sealed containers by the Contractor. Contents of each sampled container shall be mixed to render a sample truly representative of the material in that container.

One foot by 1 foot 305 millimeter by 305 millimeter sections of Roof after application of roofing felts but prior to flood coat.

Cutout sampling of the roof shall be accomplished as specified in the paragraph entitled, "Roof Cutout Samples," of this section.

Three pieces, 12 inches 300 millimeter by the width of roll of Base Sheet and Roofing Membranes.

Manufacturer's Standard Color Chart shall be submitted for Finish Coating.

#### 1.5 PROTECTION OF PROPERTY

Flame-heated equipment shall be located and used so it will not endanger the structure or other materials on the site or adjacent property. Fire extinguishers of an appropriate approved type shall be provided and maintained by the Contractor.

Flame-heated equipment shall not be placed on the roof of any structure.

Before starting work, paving and faces of building walls adjacent to the hoist and kettles shall be protected and the protection maintained for duration of work.

Work or materials damaged during the handling of bitumen and the installation of materials shall be restored to the original condition or replaced with new materials at no cost to the Government.

### PART 2 PRODUCTS

The finished surface for low-slope (less than 2:12) roofs shall have a minimum solar reflectance of 65 percent at initial installation and 50 percent after 3 years of exposure when tested in accordance with ASTM E 903.

The finished surface for high-slope (2:12 and greater) roofs shall have minimum solar reflectance of 25 percent at initial installation and 15 percent after 3 years of exposure when tested in accordance with ASTM E 903.

#### 2.1 ADHESIVES

Adhesives and Mastics shall be the types recommended by the roofing-membrane manufacturer. Adhesives shall have a working temperature range of 20 to 140 degrees F minus 7 to 60 degrees C and shall be compatible with membranes and materials to which they are bonded.

#### 2.2 ASPHALT PRIMER

Primer shall conform to ASTM D 41.

#### 2.3 ASPHALT

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**NOTE: Select type required, Type III asphalt will usually suffice.**

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Asphalt and Bitumens shall conform to ASTM D 312, [Type III] [Type IV].

#### 2.4 BASE SHEET

Base sheet shall be organic fibered Felt, asphalt saturated and asphalt coated on both sides. Asphalt coating may be compounded with a fine mineral stabilizer and surfaced with mineral dusting on one or both sides to prevent sticking in the roll. Physical requirements shall be as follows:

Width of sheet, inches: 36 plus or minus 1/4 millimeter: 915 plus or minus 6

Area of roll, square feet: 114, 171, or 228 meter: 10.6, 15.9, or 21.2

Weight per 100 square feet, pounds, minimum: 35 10 square meter, kilogram, minimum: 15.9

Weight of dry felt, 100 square feet, pounds, minimum: 5.2 10 square meter, kilogram, minimum: 2.4 kilogram

Weight of saturant (solution in carbon disulfide), per 100 square feet, pounds, minimum: 7.3 10 square meter, kilogram, minimum: 3.3

Weight of saturant per 100 square feet 10 square meter: not less than 1.40 times the weight of dry felt

Weight of coating and surfacing per 100 square feet, pounds, minimum: 18 10 square meter, kilogram, minimum: 8.2

Pliability at 77 degrees F 25 degrees C, bend for 90 degrees at 1/2-inch 13 millimeter radius, 8 of 10 strips: no cracking

Permeance, ASTM E 96, Water Method, perm, maximum: 0.5 nanogram per pascal second square meter, maximum: 0.27

Percentage by weight of mineral matter passing a No. 100 150 micrometer sieve on the basis of total weight of mineral stabilized coating and surface matter, maximum: 60 percent

Coated base sheet shall be asphalt-impregnated glass fiber felt conforming to ASTM D 2178, except that sheets shall be factory roller coated on both sides with asphalt conforming to ASTM D 312, Type IV, to bring total weight to not less than 43 pounds per square 19.5 kilogram per 10 square meter.

#### 2.5 CANTS

Cants shall be made from treated wood or treated fiberboard and shall reduce the angle covered into two equal angles. Fiberboard shall be treated for moisture resistance by an integral treatment with wax or other sizing materials or with bituminous impregnation.

#### 2.6 CEMENT

Cement for splicing laps and for flashings shall be a self-vulcanizing butyl compound workable at 20 degrees F minus 7 degrees C. Cement shall be

that recommended by the roofing membrane manufacturer.

## 2.7 NAILS AND FASTENERS

### 2.7.1 General

Nails and fasteners used with flashing membrane shall be made from nonferrous materials. When heads are less than 1 inch 25 millimeter in diameter or equivalent area, nails and fasteners shall be driven through metal disks.

### 2.7.2 Roofing Nails

Roofing nails shall be nonferrous or zinc-coated steel, with shanks not greater than 10 gage, 0.135 inch 3.5 millimeter, and not less than 12 gage, 0.106 inch 2.8 millimeter, with heads not less than 3/8-inch 10 millimeter diameter. Lengths shall be as specified. Special nails, such as the square-cut type for use with insulating concrete and gypsum decks, shall have a minimum holding power of 20 pounds 90 newton each when driven into the specified deck.

### 2.7.3 Fasteners

Fasteners shall be the self-clinching type with a minimum holding force of 20 pounds 90 newton per fastener.

### 2.7.4 Powder-Driven Fasteners

Powder-driven fasteners may be used only when approved in writing.

### 2.7.5 Metal Disks

Metal disks shall be flat and not less than 1 inch 25 millimeter in diameter. Metal disks shall be of nonferrous material compatible with the nails or fasteners.

## 2.8 FINISH COATING

### 2.8.1 General

Finish coating for Type B roofing shall be a one-part solution of chlorosulfonated polyethylene polymer mixed with ingredients such as pigments, extenders, stabilizers, accelerators, fillers, antioxidants, dispersion aids, and suitable solvents. Solution shall be uniformly smooth and capable of application over a horizontal surface to a wet-film thickness of at least 15 mils 0.38 millimeter, using brush or roller techniques. Materials compounded more than 6 months prior to the intended use shall not be used. When tested in accordance with the designated test method, the finishing material shall exhibit the following dry-film properties after curing:

<u>DESCRIPTION</u>	<u>REQUIREMENTS</u>	<u>TEST METHOD</u>
Ultimate tensile strength, psi kilopascal	600	ASTM D 412
Elongation, minimum percent		ASTM D 412

<u>DESCRIPTION</u>	<u>REQUIREMENTS</u>	<u>TEST METHOD</u>
75 degrees F	350	
20 degrees F	130	
0 degrees F	50	
24 degrees C	350	
minus 7 degrees C	130	
minus 18 degrees C	50	
Permanent set at break, maximum percent	50	ASTM D 412
Water vapor transmission, maximum perms, Water Method, 7 calendar days at room temperature	1	ASTM E 96
Water vapor transmission, maximum Nanogram per pascal second square meter, Water Method, 7 calendar days at room temperature	0.57	ASTM E 96
Water absorption, maximum percent by weight	4	ASTM D 471
Solids content, minimum percent by weight	35	ASTM D 1084
Discoloration of film, 50 hours, RS Sunlamp	Less than No. 1 color tube, Gardner Color Scale ASTM D 1544	ASTM D 1148

#### 2.8.2 Color

Color shall be [white] [green] [gray].

#### 2.9 FINISHING TAPE

[Finishing tape for Type A roofing shall be 0.022-inch 0.56 millimeter thick polyvinylfluoride film with an elastomeric adhesive on the bonding surface. Color of Type A tape shall match the color of roofing membrane.]

[Finishing tape for Type B roofing shall be of unvulcanized butyl rubber with a colored, strippable backing. Type B roofing tape shall be at least 0.022 inch 0.56 millimeter thick.]

#### 2.10 FLASHING MEMBRANES

Flashing membranes shall be the same material specified for roofing membranes.

[Prefabricated butyl shapes shall be used to waterproof corners and roof penetrations of Type B roofs.]

## 2.11 ROOFING MEMBRANES

Roofing membranes, described as follows, shall conform to the requirements specified.

Type A: Roofing membrane shall consist of a polyvinylfluoride film weathering surface, factory laminated with an elastomeric adhesive to a backing of elastomeric-bonded non-asbestos felt. Weathering surface color shall be as specified. Type A roofing membrane does not require a finish coating.

### REQUIREMENTS FOR TYPE A ROOFING MEMBRANES

Weight per 100 square feet, pounds, minimum	11.5
Weathering surface thickness, inch, minimum	0.0018
Backing thickness, inch, minimum	0.018
Total thickness, inch, minimum	0.0198
Tensile strength, 77 degrees F, pounds/ inch, minimum:	
Longitudinal, ASTM D 146 and ASTM D 828	45
Transverse, ASTM D 412	30
Flexibility on 0.1-inch mandrel, plastic film up	No cracking over a range of minus 25 to plus 140 degrees F
Permeance ASTM E 96, Desiccant Method and Water Method, perm, maximum	0.5

### REQUIREMENTS FOR TYPE A ROOFING MEMBRANES

Weight per 10 square meter, kilogram, minimum	5.2
Weathering surface thickness, millimeter, minimum	0.0457
Backing thickness, millimeter, minimum	0.457
Total thickness, millimeter, minimum	0.503
Tensile strength, 25 degrees C, newton/ meter, minimum:	
Longitudinal, ASTM D 146 and ASTM D 828	7880
Transverse, ASTM D 412	5250
Flexibility on 2.5 millimeter mandrel, plastic film up	No cracking over a range of minus

REQUIREMENTS FOR TYPE A ROOFING MEMBRANES

32 to plus 60  
degrees C

Permeance ASTM E 96, Desiccant Method and Water Method, Nanogram per pascal second square meter, maximum	0.274
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Type B: Roofing membrane shall consist of a compounded butyl-rubber sheet not less than 0.0625 inch 1.5 millimeter thick. A finish coating is required over Type B roofing membranes. Sheets shall be of the maximum width and length practical to minimize joining. Drawings indicating sheet size and layout shall be required prior to delivery of this roofing to the job site.

REQUIREMENTS FOR TYPE B ROOFING MEMBRANES

Weight per 100 square feet, pounds, minimum	38
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Total thickness, inch, minimum	0.0625
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Flexibility on 0.1-inch mandrel, plastic film up	No cracking over a range of minus 25 to plus 140 degrees F
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Permeance ASTM E 96 Desiccant Method and Water Method, perm, maximum	0.1
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Specific gravity, ASTM D 297	1.25 plus or minus 0.08
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Elongation, ASTM D 412, percent, minimum	300
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Tear resistance, Die B, ASTM D 624 pound/inch, minimum	150
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Shore A hardness, ASTM D 2240	60 plus or minus 10
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Low temperature flexibility, ASTM D 746, Procedure B at 40 degrees F	No failures
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Heat aging, ASTM D 573, 7 calendar days at 240  
degrees F, percent of unaged specimen  
value:

Tensile retention, percent	70
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Elongation retention, percent	70
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Butyl identification, ASTM D 471 tricresyl phosphate immersion	Maximum volume swell 10 percent 70 hours, 212 degrees F
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Ozone resistance, ASTM D 1149, at 50 million, 100 degrees F	parts per hundred and 20 percent
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REQUIREMENTS FOR TYPE B ROOFING MEMBRANES

extension No cracks  
after 7 calendar days

REQUIREMENTS FOR TYPE B ROOFING MEMBRANES

Weight per 10 square meter, kilogram, minimum	17.2
Total thickness, millimeter, minimum	1.58
Flexibility on 2.5 millimeter mandrel, plastic film up	No cracking over a range of minus 32 to plus 60 degrees C
Permeance ASTM E 96 Desiccant Method and Water Method, Nanogram per pascal second square meter, maximum	0.055
Elongation, ASTM D 412, percent, minimum	300
Tear resistance, Die B, ASTM D 624 kilonewton per meter, minimum	26.3
Shore A hardness, ASTM D 2240	60 plus or minus 10
Low temperature flexibility, ASTM D 746, Procedure B at 4 degrees C	No failures
Heat aging, ASTM D 573, 7 calendar days at 116 degrees C, percent of unaged specimen value:	
Tensile retention, percent	70
Elongation retention, percent	70
Butyl identification, ASTM D 471 tricresyl phosphate immersion	Maximum volume swell 10 percent 70 hours, 100 degrees C
Ozone resistance, ASTM D 1149, at 50 million, 38 degrees C	parts per hundred and 20 percent extension No cracks after 7 calendar days

2.12 SHEATHING PAPER

Paper shall be rosin-sized weighing not less than 5 pounds per 100 square feet 2.5 kilogram per 10 square meter or unsaturated felt weighing approximately 7-1/2 pounds per 100 square feet 3.7 kilogram per 10 square meter.

2.13 ROOF WALKWAYS

[Asphalt planks shall be 36 by 72 inches by 1/2-inch 915 by 1830 millimeter

by 13 millimeter thick consisting of a homogeneous core of asphalt, plasticizers, and fillers, bonded between two saturated and coated facing sheets with the top side surfaced with ceramic granules and shall conform to ASTM D 517 for mineral-surfaced asphalt plank.]

[Roof walkways shall be pressure-treated, or redwood duck boards. Duck boards shall be constructed of 1- by 4-inch 25 by 100 millimeter boards spaced 1/2 inch 13 millimeter apart, and nailed to 2- by 4-inch by 8-foot 50 by 100 by 2400 millimeter stringers at a minimum of 24 inches 600 millimeter apart. Duck boards shall be installed on 4- by 6-inch by 3-foot 100 by 150 by 900 millimeter long foundation boards spaced 4 feet 1200 millimeter apart. Foundation boards shall be installed in bitumen on the roof membrane.]

## PART 3 EXECUTION

### 3.1 PREPARATION OF SURFACES

Entire roof-deck construction of any bay or section of the building shall be completed before roofing work commences. Ambient temperature during applications using hot asphalt shall be not lower than 40 degrees F 4 degrees C; using cold adhesive exclusively, not lower than 20 degrees F minus 7 degrees C. Surface on which the roofing or flashing is to be applied shall be smooth and firm, free of projections, ice, frost, moisture, dirt, and foreign materials. Vents and other items penetrating the roof shall be secured in position and properly prepared with manufactured flashings or fittings by tradesmen responsible for the work. Storing, wheeling, or trucking will not be permitted directly on roof surfaces. Smooth, clean, board or plank runways and platforms shall be provided as required. Surfaces shall be inspected and approved immediately prior to the application of roofing.

Before being laid, the base sheet shall be stacked on end and stored for 24 hours in an area maintained at a temperature not less than 50 degrees F 10 degrees C.

### 3.2 APPLICATION OF ROOFING

Asphalt primer for concrete and masonry surfaces to receive asphalt products shall be applied at a rate of not less than 1 gallon or 7.5 pounds per square 3.8 liter or 3.4 kilogram per 10 square meter. Roofing membrane and base sheets shall be laid free of wrinkles and, in addition to being mopped in hot asphalt or cold adhesive, shall be fastened as specified. Roofing shall immediately follow insulation or underlayment application as a continuous operation, including roofing-membrane joint treatment where required. End joints of base sheets and roofing membrane shall be staggered. Joints between layers shall be staggered. Roofing membranes and base sheets shall be carried up abutting vertical surfaces at least 4 inches 100 millimeter. At eaves and rakes, base sheets and roofing membranes shall run to the outside edge of the wood edge nailer and, in addition, shall be folded back for the width of roof flange of the metal gravel stop.

### 3.3 ROOFING TYPE

[Type A roofing membranes and base sheets may be applied with either hot asphalt or cold adhesive, at the option of the Contractor. Since the Type A roofing system does not require a finish coating, care must be exercised when applying the membrane to ensure full coverage of hot asphalt or cold

adhesive without leaving an excess that will squeeze out beyond the selvage edge and discolor the surface of the roofing.]

[Type B roofing membranes shall be applied with solid coats of adhesive spread at a rate of not less than 2/3 gallon, 5 pounds, per square. 2.6 liter, 2.3 kilogram per 10 square meter. Lap areas of joints shall be cleaned with solvent and lap cement applied in accordance with the cement manufacturer's instructions. Adhesive or cement shall be allowed to dry until it does not stick to a dry-finger touch. Butyl-gum tape sufficiently wide to extend approximately 1/8 inch 3 millimeter beyond each edge of the lap area shall be applied to the lower sheet. Then it shall be applied to the tape cemented lap area of the upper sheet. Laps shall be over-sealed with butyl-gum tape centered at the lap edge. Tape for over-sealing shall be at least 3 inches 75 millimeter wide and cemented in the manner specified for tape applied between laps. Joints shall be made by rolling or pressing the butyl materials firmly in place, without bridging or wrinkling, to obtain full contact at the taped areas. Laps shall be sealed with butyl-gum tape prior to the completion of each day's work.]

### 3.4 SUBSTRATE

#### 3.4.1 Type A Roofing on Wood

Type A roofing on wood surfaces shall consist of not less than the following quantities for each square of roofing (100 square feet) (10 square meter):

<u>MATERIAL</u>	<u>POUNDS</u>
Sheathing paper	5
1 ply of asphalt-coated base sheet	35
1 mopping of asphalt	20
or	
1 coat of adhesive	10
1 ply of polyvinylfluoride membrane	11.5
1 ply of finishing tape, all joints (40 feet)	
<u>MATERIAL</u>	<u>KILOGRAM</u>
Sheathing paper	2.3
1 ply of asphalt-coated base sheet	16
1 mopping of asphalt	9.1
or	
1 coat of adhesive	4.5
1 ply of polyvinylfluoride membrane	5.2
1 ply of finishing tape, all joints (12 meter)	

One ply of sheathing paper shall be mechanically attached. One ply of the base sheet shall be applied on insulation or underlayment in a solid mopping of hot asphalt. Base-sheet application in hot asphalt over cellular-plastic polystyrene insulation shall be by the machine method



only. Hot asphalt shall not be applied directly to polystyrene insulation. Base sheet shall be lapped 4 inches 100 millimeter on edges and 6 inches 150 millimeter on ends, laid parallel to the direction of the roof slope, and fastened as specified. One ply of polyvinylfluoride membrane shall be immediately laid over the base sheet in a solid mopping of hot asphalt using 4-inch 100 millimeter selvage edge laps and 6-inch 150 millimeter end laps. Polyvinylfluoride sheets shall be oriented to the roof slope in the same manner as base sheets, and joints between layers shall be staggered. Finishing tape shall be applied firmly in place, equally overlapping both sides of all joints in the sheet roofing. Flashings shall be installed.

#### 3.4.2 Type A Roofing on Gypsum or Insulating Concrete

Type A roofing on gypsum or insulating concrete surfaces shall consist of not less than the following quantities for each square of roofing (100 square feet) (10 square meter):

<u>MATERIAL</u>	<u>POUNDS</u>
Sheathing paper	5
1 ply of asphalt-coated base sheet	35
1 mopping of asphalt	20
or	
1 coat of adhesive	10
1 ply of polyvinylfluoride membrane	11.5
1 ply of finishing tape, all joints (40 feet)	
<u>MATERIAL</u>	<u>KILOGRAM</u>
Sheathing paper	2.3
1 ply of asphalt-coated base sheet	16
1 mopping of asphalt	9.1
or	
1 coat of adhesive	4.5
1 ply of polyvinylfluoride membrane	5.2
1 ply of finishing tape, all joints (12 meter)	

One ply of sheathing paper shall be attached with adhesive (spot applied). One ply of the base sheet shall be laid over gypsum or insulating concrete, lapped 4 inches 100 millimeter on edges and 6 inches 150 millimeter on ends, laid parallel to the direction of roof slope, and fastened as specified. One ply of polyvinylfluoride membrane shall be immediately laid over the base sheet in a solid mopping of hot asphalt or coating of adhesive, using 4-inch 100 millimeter selvage edge laps and 6-inch 150 millimeter end laps. Polyvinylfluoride sheets shall be oriented to the roof slope in the same manner as base sheets, and joints between layers shall be staggered. Finishing tape shall be applied firmly in place, equally overlapping both sides of all joints in the sheet roofing. Flashings shall be installed.

### 3.4.3 Type A Roofing on Concrete

Type A roofing on concrete surfaces shall consist of not less than the following quantities for each square of roofing (100 square feet) (10 square meter):

<u>MATERIAL</u>	<u>POUNDS</u>
Asphalt primer over concrete surface	7.5
1 application of asphalt, channel, or spot mop or 1 coating of adhesive	15
1 ply of asphalt-coated base sheet	35
1 mopping of asphalt or 1 coating of adhesive	20
1 ply of polyvinylfluoride membrane	11.5
1 ply of finishing tape, all joints (40 feet)	

<u>MATERIAL</u>	<u>KILOGRAM</u>
Asphalt primer over concrete surface	3.4
1 application of asphalt, channel, or spot mop or 1 coating of adhesive	6.8
1 ply of asphalt-coated base sheet	16
1 mopping of asphalt or 1 coating of adhesive	9.1
1 ply of polyvinylfluoride membrane	5.2
1 ply of finishing tape, all joints (12 meter)	

One ply of the base sheet shall be applied over primed concrete with channel or spot mopping of hot asphalt lapped 4 inches 100 millimeter on edges and 6 inches 150 millimeter on ends, laid parallel to the direction of roof slope, and fastened as specified. One ply of polyvinylfluoride membrane shall be immediately laid over the base sheet in a solid mopping of hot asphalt using 4-inch 100 millimeter selvage edge laps and 6-inch 150 millimeter end laps. Polyvinylfluoride sheets shall be staggered. Finishing tape shall be applied firmly in place equally overlapping both sides of all joints in the sheet roofing. Cold adhesive of the type recommended by the roofing manufacturer may be used in lieu of hot asphalt and shall be applied to primed concrete. Flashings shall be installed.

### 3.4.4 Type A Roofing on Insulation or Underlayment

Type A roofing on insulation or underlayment surfaces shall consist of not less than the following quantities for each square of roofing (100 square feet) (10 square meter):

<u>MATERIAL</u>	<u>POUNDS</u>
1 mopping of asphalt	20
or	
1 coating of adhesive	15
1 ply of asphalt-coated base sheet	35
1 mopping of asphalt	20
or	
1 coating of adhesive	10
1 ply of polyvinylfluoride membrane	11.5
1 ply of finishing tape, all joints (40 feet)	

<u>MATERIAL</u>	<u>KILOGRAM</u>
1 mopping of asphalt	9.1
or	
1 coating of adhesive	6.8
1 ply of asphalt-coated base sheet	16
1 mopping of asphalt	9.1
or	
1 coating of adhesive	4.5
1 ply of polyvinylfluoride membrane	5.2
1 ply of finishing tape, all joints (12 meter)	

One ply of the base sheet shall be applied on insulation or underlayment in a solid mopping of hot asphalt. Base sheet application in hot asphalt over cellular plastic polystyrene insulation shall be by the machine method only. Hot asphalt shall not be applied directly to polystyrene insulation. Base sheet shall be lapped 4 inches 100 millimeter on edges and 6 inches 150 millimeter on ends, laid parallel to the direction of the roof slope, and fastened as specified. One ply of polyvinylfluoride membrane shall be immediately laid over the base sheet in a solid mopping of hot asphalt using 4-inch 100 millimeter selvage edge laps and 6-inch 150 millimeter end laps. Polyvinylfluoride sheets shall be oriented to the roof slope in the same manner as base sheets, and joints between layers shall be staggered. Finishing tape shall be applied firmly in place, equally overlapping both sides of all joints in the sheet roofing. Cold adhesive of the type recommended by the roofing manufacturer may be used in lieu of hot asphalt and shall be applied to primed concrete. Flashings shall be installed.

#### 3.4.5 Type B Roofing

Roofing shall be as follows:

Type B roofing on [wood] [gypsum] [insulating concrete] [concrete] [insulation] [underlayment] shall consist of not less than the following quantities for each square of roofing (100 square feet) (10 square meter):

<u>MATERIAL</u>	<u>POUNDS</u>
Adhesive, solid application	5
1 ply of butyl rubber membrane	38
Cement, all joints	Varies
2 plies of butyl tape, all joints	Varies
Finish coating: 6-mil thickness	

<u>MATERIAL</u>	<u>KILOGRAM</u>
Adhesive, solid application	2.3
1 ply of butyl rubber membrane	17.2
Cement, all joints	Varies
2 plies of butyl tape, all joints	Varies
Finish coating: 0.152 millimeter thickness	

One ply of butyl-rubber membrane shall be laid on all roof surfaces parallel to the direction of roof slope in a solid coating of adhesive using 3-inch 75 millimeter edge laps and 6-inch 150 millimeter end laps. Laps shall be sealed, and the membrane additionally fastened as specified.

### 3.5 FASTENING

#### 3.5.1 Type A Roofing Laid Directly on Deck

<u>TYPE OF DECK</u>	<u>SLOPES</u>	<u>BASE SHEET NAILING AT LAPS TO BE EXPOSED</u>	<u>MEMBRANE ROOFING</u>
Wood	All slopes	6 inches on center (oc) at laps; 18 inches oc at centerline; staggered in two rows 12 inches apart	6 inches oc at laps
Gypsum	All slopes	6 inches oc at laps; 18 inches oc at centerline; staggered in two 12 inches apart	6 inches oc at laps
Insulating concrete	All slopes	6 inches oc at laps; 18 inches oc at centerline; staggered in two rows 12 inches apart	6 inches oc at laps
Concrete	Up to 3 inches per foot	Nailing not required	Nailing not required
Concrete	Over 3 inches per	24 inches oc at laps; 24 inches oc in two	24 inches oc at side

<u>TYPE OF DECK</u>	<u>SLOPES</u> foot	<u>BASE SHEET NAILING AT LAPS TO BE EXPOSED</u> rows spaced 12 inches apart and equally distant from the centerline	<u>MEMBRANE ROOFING</u> laps and 6 inches oc at end laps. Make end laps over wood nailers where used.
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<u>TYPE OF DECK</u>	<u>SLOPES</u>	<u>BASE SHEET NAILING AT LAPS TO BE EXPOSED</u>	<u>MEMBRANE ROOFING</u>
Wood	All slopes	150 mm on center (oc) at laps; 450 mm oc at centerline; staggered in two rows 300 mm apart	150 mm oc at laps
Gypsum	All slopes	150 mm oc at laps; 450 mm oc at centerline; staggered in two rows 300 mm apart	150 mm oc at laps
Insulating concrete	All slopes	150 mm oc at laps; 450 mm oc at centerline; staggered in two rows 300 mm apart	150 mm oc at laps
Concrete	Up to 1 to 4	Nailing not required	Nailing not required
Concrete	Over 1 to 4	600 mm oc at laps; 600 mm oc in two rows spaced 300 mm apart and equally distant from the centerline	600 mm oc at side laps and 150 mm oc at end laps. Make end laps over wood nailers where used.

### 3.5.2 Type A Roofing Laid on Insulation or Underlayment

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**NOTE: Applicable for elastic sheet roofing applied on slopes over 3 inches per foot 1 to 4. Nailing not required on slopes 3 inches per foot 1 to 4 or less.**  
 \*\*\*\*\*

<u>TYPE OF DECK</u>	<u>NAILABLE INSULATION*</u>	<u>NON-NAILABLE INSULATION</u>
All decks	Nail base sheet 12 inches oc at side laps and at	Nail into surface-mounted roof nail-

<u>TYPE OF DECK</u>	<u>NAILABLE INSULATION*</u>	<u>NON-NAILABLE INSULATION</u>
	longitudinal centerline; nail roofing membrane at 3 inches oc at end laps	ing strips. Nail the base sheet into each nailing strip at laps and in two rows spaced 12 inches apart and equally distant from the centerline. Nail roofing membrane 6 inches oc at end laps. Make end laps over nailing strips.
Concrete	Nail base sheet 24 inches oc at side laps and at longitudinal centerline; nail roofing membrane at 6 inches oc at end laps when nailing through insulation into concrete. Make end laps over wood nailers in concrete.	Same as above
Wood	Nail base sheet 24 inches oc at side laps and at longitudinal centerline; nail roofing membrane at 6 inches oc at end laps when nailing through insulation into wood.	Same as above
Gypsum, insulating concrete	Nail base sheet 12 inches oc at side laps and at longitudinal centerline; nail roofing membrane at 4 inches oc at end laps when nailing through insulation into gypsum.	Same as above
Steel	Nail into insulation only.	Nailable insulation only.
<u>TYPE OF DECK</u>	<u>NAILABLE INSULATION*</u>	<u>NON-NAILABLE INSULATION</u>
All decks	Nail base sheet 300 mm oc at side laps and at longitudinal centerline; nail roofing membrane at 75 mm oc at end laps	Nail into surface-mounted roof nailing strips. Nail the base sheet into each nailing strip at laps and in two rows spaced 300 mm apart and equally distant

<u>TYPE OF DECK</u>	<u>NAILABLE INSULATION*</u>	<u>NON-NAILABLE INSULATION</u> from the center-line. Nail roofing membrane 150 mm oc at end laps. Make end laps over nailing strips.
Concrete	Nail base sheet 600 mm oc at side laps and at longitudinal centerline; nail roofing membrane at 150 mm oc at end laps when nailing through insulation into concrete. Make end laps over wood nailers in concrete.	Same as above
Wood	Nail base sheet 600 mm oc at side laps and at longitudinal centerline; nail roofing membrane at 150 mm oc at end laps when nailing through insulation into wood.	Same as above
Gypsum, insulating concrete	Nail base sheet 300 mm oc at side laps and at longitudinal centerline; nail roofing membrane at 100 mm oc at end laps when nailing through insulation into gypsum.	Same as above
Steel	Nail into insulation only.	Nailable insulation only.

\* An insulation allowing penetration of nails or fasteners is required; it shall provide each nail or fastener with not less than 20 pounds 90 newton of holding force.

### 3.5.3 Type B Roofing Laid Directly on Deck

<u>TYPE OF DECK</u>	<u>SLOPES</u>	<u>BASE SHEET NAILING AT LAPS TO BE EXPOSED</u>	<u>MEMBRANE ROOFING</u>
Wood	3 inches per foot or less	Base sheet not required	Nailing not required
Gypsum	3 inches per foot or less	Base sheet not required	Nailing not required
Insulating concrete	3 inches per foot or less	Base sheet not required	Nailing required
Concrete	3 inches per	Base sheet not	Nailing not

<u>TYPE OF DECK</u>	<u>SLOPES</u>	<u>BASE SHEET NAILING AT LAPS TO BE EXPOSED</u>	<u>MEMBRANE ROOFING</u>
	foot or less	required	required
Wood	Over 3 inches per foot	Base sheet not required	6 inches oc at end laps
Gypsum	Over 3 inches per foot	Base sheet not required	3 inches oc at end laps
Insulating concrete	Over 3 inches per foot	Base sheet not required	3 inches oc at end laps
Concrete	Over 3 inches per foot	Base sheet not required	6 inches oc at end laps. Make end laps over wood nailers where used.

<u>TYPE OF DECK</u>	<u>SLOPES</u>	<u>BASE SHEET NAILING AT LAPS TO BE EXPOSED</u>	<u>MEMBRANE ROOFING</u>
Wood	1 to 4 or less	Base sheet not required	Nailing not required
Gypsum	1 to 4 or less	Base sheet not required	Nailing not required
Insulating concrete	1 to 4 or less	Base sheet not required	Nailing required
Concrete	1 to 4 or less	Base sheet not required	Nailing not required
Wood	Over 1 to 4	Base sheet not required	150 mm oc at end laps
Gypsum	Over 1 to 4	Base sheet not required	75 mm oc at end laps
Insulating concrete	Over 1 to 4	Base sheet not required	75 mm oc at end laps
Concrete	Over 1 to 4	Base sheet not required	150 mm oc at end laps. Make end laps over wood nailers where used.



<u>TYPE OF DECK</u>	<u>SLOPES</u>	<u>BASE SHEET NAILING AT LAPS TO BE EXPOSED</u>	<u>MEMBRANE ROOFING</u>
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#### 3.5.4 Type B Roofing Laid on Insulation or Underlayment

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**NOTE: Applicable for elastic sheet roofing applied on slopes over 3 inches per foot 1 to 4. Nailing is not required on slopes 3 inches per foot 1 to 4 or less.**

\*\*\*\*\*

<u>TYPE OF ROOFING</u>	<u>TYPE OF DECK</u>	<u>NAILABLE INSULATION*</u>	<u>NON-NAILABLE INSULATION</u>
Anchoring into insulation	All decks	Nail roofing membrane 4 inches oc at end laps	Nail to surface-mounted roof nailing strips provided. Nail roofing membrane 6 inches oc at end laps. Make end laps over nailing strips.
Anchoring into deck	Concrete	Nail roofing membrane 6 inches oc at end laps when nailing through insulation into concrete. Make end laps over wood nailers in concrete.	(Same as for nailable insulation)
Anchoring into deck	Gypsum	Nail roofing membrane 6 inches oc at end laps when nailing through insulation into wood.	(Same as for nailable insulation)
Anchoring into deck	Gypsum	Nail roofing membrane at 4 inches oc at end laps when nailing through insulation into gypsum.	(Same as for nailable insulation)
Anchoring into deck	Steel	Nail into insulation only.	Nailable insulation only
<u>TYPE OF ROOFING</u>	<u>TYPE OF DECK</u>	<u>NAILABLE INSULATION*</u>	<u>NON-NAILABLE INSULATION</u>
Anchoring into insulation	All decks	Nail roofing membrane 100 mm oc at end laps	Nail to surface-mounted roof nailing strips pro-

<u>TYPE OF ROOFING</u>	<u>TYPE OF DECK</u>	<u>NAILABLE INSULATION*</u>	<u>NON-NAILABLE INSULATION</u> vided. Nail roof- ing membrane 150 mm oc at end laps. Make end laps over nailing strips.
Anchoring into deck	Concrete	Nail roofing mem- brane 150 mm oc at end laps when nailing through insulation into concrete. Make end laps over wood nailers in concrete.	(Same as for nail- able insulation)
Anchoring into deck	Gypsum	Nail roofing mem- brane 150 mm oc at end laps when nailing through insulation into. wood.	(Same as for nail- able insulation)
Anchoring into deck	Gypsum	Nail roofing mem- brane at 100 mm oc at end laps when nailing through insu- lation into gypsum.	(Same as for nail- able insulation)
Anchoring into deck	Steel	Nail into insula- tion only.	Nailable insula- tion only

\* An insulation allowing penetration of nails or fasteners is required; it shall provide each nail or fastener with not less than 20 pounds 90 newton of holding force.

### 3.6 FINISH COATING FOR TYPE B ROOFING

Surface of Type B roofing and flashing membrane shall be covered with a finish coating applied with pressure roller equipment, except that a standard roller or brush may be used in restrictive working areas and as otherwise approved. Control of the film thickness shall be the responsibility of the Contractor. Thickness of the film shall be frequently checked by the use of an approved wet -mil thickness gage millimeter. In addition, Contractor shall maintain a careful balance between material consumption and area covered. Contractor may, as an aid toward proper application, change film color between adjacent underlying coats. Each coat shall be spread at a rate of not less than 3/4 gallon per square 2.8 liter per 10 square meter per coat to a total dry-film thickness of not less than 6 mils, 0.006 inch 0.15 millimeter.

### 3.7 FLASHINGS

#### 3.7.1 General

Flashings shall be provided in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

A one-ply flashing membrane, as specified for the system used, shall be provided and installed immediately after the roofing membrane is placed and prior to finish coating where a finish coating is required. Flashings shall be stepped where vertical surfaces abut sloped roof surfaces. Sheet metal reglet in which sheet metal cap flashings are installed shall be not more than 16 inches 400 millimeter nor less than 8 inches 200 millimeter above the roofing surfaces. Exposed joints and end laps of flashing membrane shall be made and sealed in the manner required for roofing membrane.

#### 3.7.2 Base Flashing

Base flashing membrane shall be laid in not more than 12-foot 3650 millimeter lengths into flashing cement applied in accordance with the roofing manufacturer's directions. Flashing membranes may be applied in continuous lengths as working areas permit. Membrane shall extend at least 4 inches 100 millimeter onto the roof, over the cant, and up the vertical surface to the sheet metal reglet or to the top of the curb where sheet metal reglets are not required. Flashing membrane shall be secured at the top, 8-inches 200 millimeter center with nonferrous metal nails or fasteners.

#### 3.7.3 Cants

Cants shall be installed in the angles formed at walls and other vertical surfaces as a backing for base flashings. Cants shall be laid in a solid coat of adhesive immediately before laying the roofing membrane. Cants shall have a 5-1/2-inch 140 millimeter face dimension and shall be continuous and installed in lengths that are as long as practical. Installation of cants shall not be required at locations where cast-in-place cants have been integrally formed with the structural deck or roof fill.

#### 3.7.4 Strip Flashings

Roof flanges of sheet metal flashings, such as fascias, base flashings, and plumbing flashings furnished and installed under other sections of the specifications, shall be stripped with flashing membrane. After installation of metal flashings over the roofing membrane, strip flashing membrane centered longitudinally at edges of roof flanges shall be installed into flashing cement applied in accordance with the roofing manufacturer's directions to form a waterproof joint between the roofing membrane and the metal flashings.

#### 3.7.5 Valleys

Roofing shall be applied at valleys and waterways in the following manner:

Base sheets shall continue across valleys and shall terminate at approximately 18 inches 450 millimeter from the valley.

Roofing membrane laid across valleys shall terminate at approximately 12 inches 300 millimeter from the valley. Exposed lap shall terminate on a line approximately 12 inches 300 millimeter from and parallel to the valley gutter and shall be treated as an end lap.

Roofing membrane and the base sheet may be laid across or parallel to shallow valleys such as those formed by a reverse-slope roof, provided applications can be completed without wrinkles, buckles, or fishmouths and side laps do not face the direction of drainage.

#### 3.7.6 Valley Application

Valleys: Roofing shall be applied at valleys and waterways in the following manner:

Base sheets shall continue across valleys and shall terminate at approximately 18 inches 450 millimeter from the valley.

Felt plies shall continue across valleys and terminate at approximately 12 inches 300 millimeter from the valley. Exposed laps shall terminate on a line approximately 12 inches 300 millimeter from and parallel to the gutter valley. Two plies of felt, 9 and 12 inches 230 and 300 millimeter wide, shall be successively mopped in over each felt line-of-termination.

If the application can be completed without wrinkles, buckles, or fishmouths, and if side laps do not face the direction of drainage, roofing felts and base sheets may be laid continuously across or parallel to shallow valleys such as those formed by reverse-slope roofs. For this application, valleys shall be reinforced with one ply of felt, 36-inches 900 millimeter wide, centered on the valley gutter and laid in a solid mopping of asphalt over the top ply of roofing.

#### 3.7.7 Walkway Application

\*\*\*\*\*  
NOTE: Drawings must indicate areas where walkways  
are required. 1-inch 25 millimeter thick walkways  
can be obtained by laminating two 1/2-inch 12.5  
millimeter thick boards.  
\*\*\*\*\*

[Asphalt plank walkway systems for the protection of the roofing membrane shall be installed as indicated.]

Walkway systems for the protection of the roofing membrane shall be furnished and installed as indicated.]

[A heavy coating of hot asphalt shall be applied over the designated walkway areas and directly on the felt membrane. While the asphalt is still hot, asphalt planks shall be laid in. A space 1/2-inch 13 millimeter wide shall be allowed between adjacent boards for drainage.]

After placing the boards, flood coating and aggregate surfacing of the roof shall be completed up to all edges of the installed planks.]

#### 3.7.8 Roof Vent Application

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**NOTE: Where vapor barriers are required, roof vents must be included to prevent water accumulation in the roof sandwich.**

\*\*\*\*\*

Roof vents shall be provided on the minimum basis of one roof vent for each 1,200 square feet 110 square meter of roof area, with no point on the roof more than 45 feet 13.7 meter from a point of venting. Roof vents shall be 22-gage 0.85 millimeter galvanized steel conforming to ASTM A 924/A 924M and ASTM A 653/A 653M, G165 Coating Designation.

Roof vents shall be cylindrical, not less than 6 inches 150 millimeter in diameter, and 8 inches 100 millimeter high. A conical weather cap, cone-base diameter 12 inches 300 millimeter and cone height 6 inches 150 millimeter, shall be securely fastened to the top of each roof vent by galvanized strap brackets. At roof end of the vent, a 12-inch 300 millimeter flashing flange shall be securely brazed to the vent cylinder approximately 3/8 inch 9.5 millimeter from the end.

Roof vents shall be installed before the flood coat is applied. Contractor may, at his option, temporarily omit the flood coat and aggregate surfacing at the location of the roof vents. Such areas shall be not less than 30 inches 760 millimeter nor more than 48 inches 1220 millimeter in diameter and shall be effectively glazed-in when the adjacent surfaces are flood coated.

\*\*\*\*\*

**NOTE: Select the following paragraph only when mineral-fiberboard insulation is required.**

\*\*\*\*\*

[To install roof vents in roofs with mineral-fiberboard insulation, a circular hole shall be cut through the membrane and the top layer of insulation, but not into the bottom layer of insulation. Hole shall snugly accept the vent cylinder.]

\*\*\*\*\*

**NOTE: Select the following paragraph only when cellular-glass insulation is required.**

\*\*\*\*\*

[Vents in roofs with cellular-glass insulation shall be installed astride one of the joints in the insulation, to give access to the chamfered venting channels. Roof flanges of the vents shall be flush with the end of the vent; the cap sheet of the top layer of insulation shall be removed within the circular area of the vent cylinder.]

Roof vent shall be set over the hole with the flashing flange set in hot steep asphalt. Flashing shall be applied successively, with two plies, 24 inches 600 millimeter square on the bottom and 30 inches 760 millimeter square on the top, set in hot moppings of asphalt at a 20-pound-per-square 9.1 kilogram per 10 square meter rate. Over the top ply, a flood coat and aggregate surfacing shall be applied to match the surrounding areas.

### 3.8 FIELD TESTING ROOF CUTOUT SAMPLES

#### 3.8.1 Roof Cutout Samples

After completion of the application of roofing felts, but prior to the

application of the flood coat, not less than two sample cutouts of the roofing shall be taken from the deck for each 50 squares 500 square meter or less at locations as directed. Cutout samples will be visually examined for free water between plies or skips in bitumen application between plies and then weighed to determine the total amount of bitumen used, exclusive of the flood coat. Samples shall be 1 foot by 1 foot 305 millimeter by 305 millimeter in area, accurately cut to a template. Thickness and weight of the samples shall be as specified for the applicable condition.

Not less than two samples shall be cut from the roof of each wing of the building covering 100 squares 1000 square meter or less. One sample shall be taken each day on which approximately 25 squares 250 square meter have been laid. An additional sample shall be taken for each 100 squares 1000 square meter or fraction thereof over 100 squares. 1000 square meter.

Sample-cutting device shall be square and properly sized as indicated above. Device may be a self-cutting type or a metal template capable of being secured to the roof for use with a sharp roofing knife. Cutting edges of the device or knife shall be kept clean by washing in a proper solvent after each cut.

Weight of the sample shall be not less than [\_\_\_\_\_].

Complete sampling operation, except weighing, shall be performed without additional cost to the Government. Scales for weighing the samples will be furnished by the Contracting Officer.

Scales for weighing samples will be portable, graduated, and accurate to 1/2 ounce 14 gram.

Free water between plies or the absence of bitumen between plies shall be cause for removal of the affected portions of the roof and their replacement in a dry condition. Where only bitumen deficiencies are found, the deficient areas shall have an additional ply of felt applied in a full mopping of bitumen. Correction of the above deficiencies shall be made at no additional cost to the Government.

If there is a deficiency of bitumen in 25 percent of the total deck area, the Contractor shall add an additional ply of felt over the entire deck in a full mopping of the bitumen specified.

Immediately after being weighed, the sample shall be replaced and tamped into position in the cutout area which meanwhile has been flooded with hot bitumen; the area shall then be covered with 3 plies of felt hot mopped in place, with the first ply overlapping the cutout area 3 inches 75 millimeter on all sides and each succeeding ply overlapping the preceding ply 3 inches 75 millimeter on all sides.

Should it become impossible to immediately replace the cutout sample in the roof, a new section of equivalent size and structure shall be substituted. A dry sheet of the same type of cutout shall be placed in the bottom of the cutout before flooding to prevent dripping of bitumen through the deck.

Contracting Officer may waive taking roof cutout samples at his discretion, and the credit involved shall be returned to the Government.

### 3.8.2 Testing Procedures

Roof samples will be sent to a recognized testing laboratory where a piece

of each sample measuring 4 inches by 12 inches 100 millimeter by 300 millimeter will be cut off, plainly identified, and retained by the laboratory for not less than 6 months.

The remaining part of the 1-foot by 1-foot 305 millimeter by 305 millimeter samples will be qualitatively and quantitatively tested to determine compliance with the requirements of these specifications.

If test results show compliance with the requirements of these specifications, the Government will pay for the testing. If the test results indicate quantitative or qualitative deficiencies, the following procedure shall be automatically invoked:

Contractor shall pay for the test which revealed the deficiency.

Four locations peripheral to the original location of the deficient cut and approximately 10 feet 3 meter therefrom will be designated. Additional cuts shall be taken at these locations to determine whether the deficiency was strictly local or whether a larger area was involved. Contractor shall be responsible for the costs of this testing. Contractor shall repair the roof as specified and at no additional cost to the Government.

After an area of deficiency has been identified, requiring either application of additional felts and asphalt, or an additional flood coat, or both, depending upon the nature and magnitude of the deficiencies, the aggregate surfacing shall be completely removed. If flood coating alone is required, deeply embedded aggregate may be flooded in. If additional felts are required, aggregate too deeply embedded to remove shall be completely flooded in before any felt laying is begun.

### 3.9 ACCEPTANCE

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NOTE: Following a minimum of 90 calendar days operation (or installation), but no later than one year, the Systems Engineer/Condition Monitoring Office/Predictive Testing Group should inspect the installation using advanced monitoring technologies such as Infrared Imaging or Ultrasonic mapping. These technologies can identify insulation voids, insulation settling, and areas of moisture intrusion. Identification of insulation materials and locations is required to effectively identify these types of problems. The Systems Engineer/Condition Monitoring Office/Predictive Testing Group needs to know the warranty expiration date, if there is a warranty, in order to perform the inspections within the prescribed time frame.

\*\*\*\*\*

Prior to final acceptance, the Contractor shall provide construction (as-built) details [and warranty information] to the Contracting Officer. Construction details shall include, by building area, the material type, amount, and installation method. An illustration or map of the building may serve this purpose. Data shall have a cover letter/sheet clearly marked with the system name, date, and the words "As built

insulation/material." Forward as-built [and warranty] information to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database.

-- End of Section --